2003-01

Structuration theory: its potential impact on logistics research

Lewis, Ira

Emerald

International Journal of Physical Distribution & Logistics Management, v.33, no.4, 2003, pp. 296-315.

Received February 2002
Revised September 2002,
January 2003

Structuration theory: its potential impact on logistics research

Ira Lewis and Jim Suchan
Naval Postgraduate School, Monterey, California, USA

Keywords *Logistics, Research, Information technology, Supply-chain management, Communications*

Abstract *While the physical paths that goods traverse are being simplified, the capture, storage, processing and dissemination of information associated with logistics has become considerably more complex. Logistics researchers need to better understand the behavioral and managerial issues created by information technology implementation. The paper suggests that structuration theory, a research approach derived from sociology that has become well established in the study of information systems, can contribute to that understanding. This paper introduces logistics researchers to structuration theory as a useful theoretical framework that can help understand the relationship between technologies, the people who interpret them, and the patterns of use that stem from that interpretation.*

Introduction

The evolution of advanced information technologies (AITs) is having a fundamental impact on the physical and information flows that characterize logistics activities. Although the physical paths goods traverse are being simplified due, in part, to outsourcing (Sarkar *et al.*, 1998; Lewis and Talalayevsky, 2000), the ability of AITs to capture, process, store, and disseminate large amounts of supply chain information has significantly increased the complexity of organizational members' and suppliers' tasks, and made more dynamic the systems within which they work.

Following DeSanctis and Poole (1994), we define AITs as the tools, techniques, and knowledge (e.g. collaborative customer management and supply chain management (SCM) systems, groupware such as e-mail and intranets, and decision support systems) that promote participation in organizational and inter-organizational activities by a wide range of organizational members and stakeholders. These AITs can make real-time information available to members at all levels in the organization, to suppliers, and to customers. If this information and knowledge is used wisely, organizations can build customized relationships with their suppliers and customers, leading to a significant strategic advantage over competitors.

Effectively adopting and implementing AITs to strategically manage supply chain information, communication, and relationships is not only a

International Journal of Physical Distribution & Logistics Management
Vol. 33 No. 4, 2003
pp. 296-315

0960-0035
DOI 10.1108/09600030310478784

technical but also a managerial challenge. More specifically, understanding how AITs affect the managerial and behavioral management components of the logistics framework and the larger organization systems within which that framework is embedded is key to helping us understand how organizational agents, such as individuals, groups, departments, divisions, or even whole enterprises interpret, implement, resist, and use AITs.

However, Lambert *et al.* (1998) point out that these behavioral elements are difficult to assess because they represent complex process interactions that can only be understood over time. This difficulty creates significant problems if the effect of AITs on people, processes, and the internal and external SCM systems are to be understood, diagnosed, and aligned with large-scale organizational systems. Stock (2001) emphasized that "SCM allows multiple theories, concepts, principles, and methods to be used in the identification and solution of SCM-related problems and issues". We strongly believe that structuration theory, a research approach derived from sociology that is becoming well established in information systems and organizational behavior research, can help researchers better understand the behavioral SCM issues and problems that AIT implementation and use create. Consequently, the purpose of this paper is to introduce logistics researchers to structuration theory as a useful theoretical framework that may help them to understand better the relationship between AITs, the people who interpret them, and the patterns of use that stem from that interpretation.

Clearly, the theoretical framework suggested by structuration could be applied to a wide range of SCM issues including any kind of interface between man and machines. However, we focus on AITs so as to provide a specific, easy-to-understand application of structuration theory, to capitalize on the research done in the information technology (IT) field, and to treat an area having a significant impact on SCM managerial processes.

This paper is organized as follows:

(1) a brief overview of current logistics research that points out the limitations of variance theories and the need for process theories and an interpretivist framework to understand better the behavioral complexity or dimensionality of supply chains;

(2) an overview of structuration theory with illustrations of how this theory can help us understand AITs behavioral impact on SCM issues;

(3) a brief case that applies structuration theory in a systematic manner;

(4) a description of the data gathering methods needed to use the structuration theory lens and the limitations of these methods;

(5) final observations that describe the disciplinary challenges logistics may face in adopting the interpretivist framework that structuration theory and other similar theoretical frameworks require.

The need for process-based theories in logistics research

Seaker *et al.* (1993) described logistics as "a relatively new field of study that is characterized by emerging opportunities and changing research requirements". Stock (1990, 1997) and McGinnis *et al.* (1994) suggested that logistics should look to other disciplines to determine whether developments within the field constitute progress. Critical of the state of logistics research at the time, Stock (1990) expressed the following view:

> The role of logistics in contributing to the social welfare will start to crystallize as logistics is viewed from a larger perspective. If logistics is viewed strategically and more broadly to include marketing, planning, and strategy, additional opportunities exist for academicians involved in scholarly research. Current academicians and practitioners will have to see themselves as change agents and work to break apart the provincialism of traditional logistics.

The above researchers also expressed the view that logistics research had adopted a strong positivist approach toward how knowledge was created. That approach, which theorizes that behavior can be predicted and that cause-and-effect relationships are clear and pervasive, contrasts sharply with interpretivism, which seeks to understand the subjective individual and organizational processes that shape and control behavior. From the interpretivist perspective, explanations of behavior, indeed virtually all aspects of organizational life, are socially constructed. Consequently, to understand the processes that constructed that behavior, researchers must gather data that reveal workers' subjective experiences, the interpretive lenses that give meaning to that experience, and the organizational factors and contexts that create common organizational interpretive lenses.

The field of management generally, and in particular research into the impact of AITs on management practices, has benefited from both positivist and interpretivist frameworks. However, there is increasing realization that the positivist framework may be imposing limitations on our understanding of organizations. As explained by Edwards (2000), "scholars now contend that innovation is best understood as a dynamic, ongoing process during which actions and institutional structures are inextricably linked".

Process-based theories, which fall within the interpretivist tradition, suggest that behavior cannot be predicted either by the intentions of individual actors or by discrete changes in environmental conditions such as the implementation of AITs (Markus and Robey, 1988). In contrast, variance theories, which stem from a positivist tradition, view the precursor or cause as a necessary and sufficient condition for the expected outcome to occur. For example, the well-known prediction by Leavitt and Whisler (1958) that IT would always cause organizational centralization is an example of a variance theory. Table I outlines the key differences between the logical frameworks associated with variance and process theories.

	Variance theory	Process theory
Definition	The cause is necessary and sufficient for the outcome	Causes result from socially constructed, subjective experiences
Role of time	Static	Longitudinal
Assumptions	Behavior can be predicted or modeled	Behavior can be understood in relation to organizationally-specific context factors
Research methods	Surveys	Case studies, action research, ethnographic and cultural studies
Level of analysis	Macro	Blend of macro and micro

Source: Based on Markus and Robey (1988)

Table I.
Logical structure of variance and process theories

Variance theories are consistent with the use of surveys, which are the dominant form of research in logistics management. Dunn *et al.* (1993), in their review of four leading logistics journals, found that only 2 percent of the articles published were based on methods such as case studies or action research. In contrast, 36 percent used surveys or interviews, while 25 percent used modeling and simulation. Mentzer and Kahn (1995) stated that the majority of published literature in the *Journal of Business Logistics* consisted of normative research or literature reviews.

The interpretivist framework and the process theories that define that framework suggest that social relationships, such as those that characterize the relationships between the members of a supply chain, are far too complex to be modeled through use of surveys. Methodologies that capture members' subjective experiences, their interpretation of that experience, and the actions that result from that interpretation are required to understand SCM behavior. The increasing complexity of logistics partly caused by the increasing interconnectedness of supply chain members from organizations with different missions, goals, strategies, and tactics may lead logistics researchers to consider greater use of process theories to better understand the impact these behavioral factors have on SCM. Kent and Flint (1997) suggested that a "deeper understanding of behavioral issues" in logistics research would emerge, with a particular need for "solid theory based on sound empirical examination of construct relationships over multiple industries and situations". Mentzer (2001), in summarizing the findings of an edited collection of papers on SCM, explained the challenge as follows:

> Although much of traditional SCM research has looked at the operational and financial aspects of supply chains, it is apparent from this book that much of what must be managed in supply chains falls within the realm of behavioral research. How functions within a company can be integrated, how companies can coordinate their activities, and the chain of customer service to customer satisfaction to customer value all represent opportunities to bring the insights of behavioral research to what we know about supply chains.

However, logistics researchers may not have fully appreciated the required shift in thinking required of logistics researchers to add an interpretivist paradigm and the requisite theoretical frameworks to their collective research "toolkits", nor the barriers that will make that change difficult. As SCM has become an accepted concept in logistics, the challenge of managing numerous complex relationships with other members of the supply chain, including the capture, analysis, and distribution of information associated with physical goods, has become a major issue.

Due to the predominance of positivist approaches in logistics, the most common response to the challenge of increased complexity in SCM by logistics researchers has been to suggest the decomposition of supply chains into simplified structures that can then be analyzed to determine appropriate managerial action to be taken to oversee that part of the distribution channel. For example, Lambert *et al.* (1998) suggested that supply chains could be characterized as networks of multiple tiers of suppliers and customers surrounding a focal firm. The links between member firms in the supply chain could then be easily divided into categories, based on whether the links related to key processes, or whether the links are actively managed or more passively monitored. Similarly, Cooper *et al.* (1997) proposed a "value tree" approach to supply chains. In that simplified analogy, the trunk of the tree represents the focal firm, with customers as the roots and suppliers as branches of the tree. The roots and branches may subdivide to represent multiple tiers of customers or suppliers.

The above approaches seek to deal with the complexity – or dimensionality – of supply chains by abstracting complex relationships and reducing them to reasonably simple, rational models. For each defined category of link within the supply chain, firms should adopt a corresponding strategy for managing that link. Large numbers of suppliers or customers, changes in the composition or nature of the supply chain, interruptions in the flow of physical goods or information, or uncertainty about any aspect of a relationship within the chain are generally perceived to have an appropriate managerial response. These approaches to SCM may be attempting to overly simplify the complex interactions and behaviors that occur within supply chains (Mears-Young and Jackson, 1997).

In contrast, Choi *et al.* (2001), inspired, in part, by research in complexity theory and the natural sciences, characterized supply chains as "complex adaptive systems" (CASs). CASs represent aggregations of autonomous agents whose degree of autonomy and whose predictability of behavior is related to the degree of connectivity between them. Such systems emerge "over time without any singular entity deliberately managing or controlling it". Also, a CAS both reacts to and creates its own environment.

In other words, as the system adds new or even redundant suppliers to meet newly anticipated demands for products or services of end consumer markets

(a strategic reaction to the environment based on environmental scanning), the addition of these primary and tertiary suppliers creates new interconnections within the supply chain – a system-created environment. These additional interconnections both reshape the system and create emerging patterns of thinking and action (what Choi *et al.* (2001) call interpretive schema) that reinterpret end consumer market needs. The characterization of supply chains as CASs challenges the positivist approach that has dominated logistics research, while giving credence to the value of alternative, more process-oriented approaches such as interpretivism (Markus and Robey, 1988).

Research methods that seek to impose a purely positivist perspective on supply chains may not explain the breadth of phenomena that occur within the networks of organizations and individuals involved in the movement and storage of physical goods. In the following sections, we provide an explanation of how one interpretivist approach, structuration theory, could be used to capture complexity and enrich the study and understanding of logistics.

An overview of structuration theory

"Structure" has a non-traditional definition within the theoretical framework of structuration. Structure is traditionally seen as the formal and informal links of organizational activities and elements (e.g. job specialization, departmentalization, and functional, divisional, and matrix designs) that enable organizational work to get done. However, viewed through the structuration theory lens, structures are codes of behavior, implicit stores of knowledge that exist in workers' heads, that steer individual and collective organizational action (Giddens, 1979, 1984). In other words, structures are workers' mental blueprints for action within specific organizational contexts (e.g. meetings with suppliers or customers, assessments of how suppliers and customers will use new information technologies, interactions with superiors, etc.). As the "code" and "blueprint" metaphors suggest, these templates or organizing patterns and the behaviors that result from them are malleable or, as DeSanctis and Poole (1994) characterize them, "softly deterministic".

Structures are either reinforced or modified, sometimes radically but more often than not incrementally, by individual actions and, in general, by the flow of ongoing organizational behavior. For example, organizational members' repeated and continual use of e-mail to share complex ideas with suppliers rather than the telephone, face-to-face, or video teleconferencing both reflects and reinforces the current pattern of thinking about successful communication and e-mail as an appropriate media choice as well as steers future communication media choice behavior. In short, people's actions reproduce structures and, simultaneously, are guided by them. As Figure 1 illustrates, there is a recursive, reinforcing relationship between structures and people's actions or behaviors.

Figure 1 implies that the key to this structuration process is the interplay between the structures that simultaneously guide, regulate, and reflect behavior and individuals' willingness to reproduce and thus reinforce current structures through expected behavior, as illustrated in the e-mail use example above. Additionally, structures may be modified minimally, significantly, or radically through ongoing new behavior. What can trigger new behavior that can alter structures are events such as significant economic changes (e.g. the dot-com implosion), mergers and acquisitions, and, as we discuss next, AIT adoptions.

Barley (1986) applies the structuration theory framework to AITs. He argues that organizations' adoption of these technologies and the initial changes in thinking and behavior that may result from that adoption may create enough of a behavioral disruption to alter structures and thus create a modified code of, or blueprint, for behavior. For example, Barley researched the effect of computerized tomography (CT) scanners on institutional roles and patterns of interaction in hospital radiology departments. Barley demonstrated that CT scanners represented an AIT that was both a physical and a social object capable of triggering different behavior dynamics, hence varying degrees of "disruption", in organizations. Specifically, radiologists and technicians in two hospitals interpreted in very different ways the complexity, value, and use of the same CT technology, thus causing a significant change in job role, power relations, and communication between radiologists and technicians in one hospital and minimal, if any change, in another.

Barley's (1986) research caused him to reject the deterministic, one-dimensional view that AITs are self-evident artifacts whose use and impact on behavior is obvious and uniform across organizations. AITs are viewed by Barley (1986), as they are by Weick (1990), as having equivocal effects, thus allowing for various interpretations and different behaviors resulting from those interpretations. In short, organizational members' interpretations of an AIT and its physical properties influence how the technology can be used, what it will do, and its contribution to organizational effectiveness.

The structuration theory perspective enabled Barley (1986) to conclude that an AIT exists as a socially constructed object uniquely situated within ongoing organizational action – a technology can only be understood within the context of its routine workday use and the existing structures that shape that use.

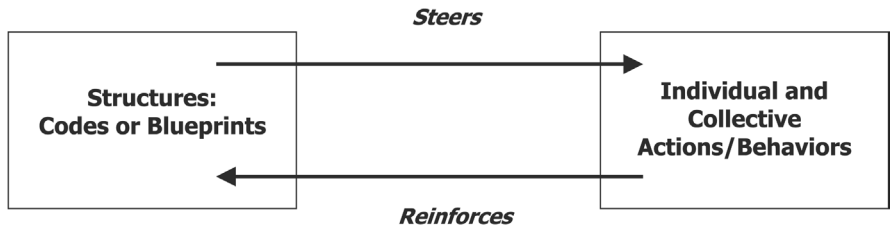

Figure 1.
The reciprocal interaction between structures and behavior

Consequently, researchers need to examine how an AIT is interpreted, the influence that prevailing organizational structures (codes or blueprints) have on that interpretation, how that interpretation affects, over time, the way and the degree to which the AIT is incorporated into the everyday life of organizational members, and the behavioral disruptions or accommodations to these codes the technology generates. Figure 2 outlines this relationship between:

- AIT as an artifact that has embedded within it, features reflecting designers' intended use;
- organizational members' interpretations of the AIT;
- the structures that influence AIT interpretation and influence strongly ongoing organizational behavior; and
- the behaviors that are both influenced by and reinforce those structures.

Figure 2 also shows that over time (times B and C) that the interplay between these four factors (listed above) may, to varying degrees, alter both structures and the behaviors influenced by them.

DeSanctis and Poole (1994) extend Barley's (1986) application of structuration theory by focusing in greater detail on the specific reasons why the same technology can significantly alter behavior patterns and, over time, structures in one organization but have little impact on behavior and structures in another. Calling their framework "adaptive structuration theory". DeSanctis and Poole (1994) examine the interplay between expected structures or blueprints for behavior that AIT designers explicitly or implicitly build into their systems and the structures (e.g. patterns of

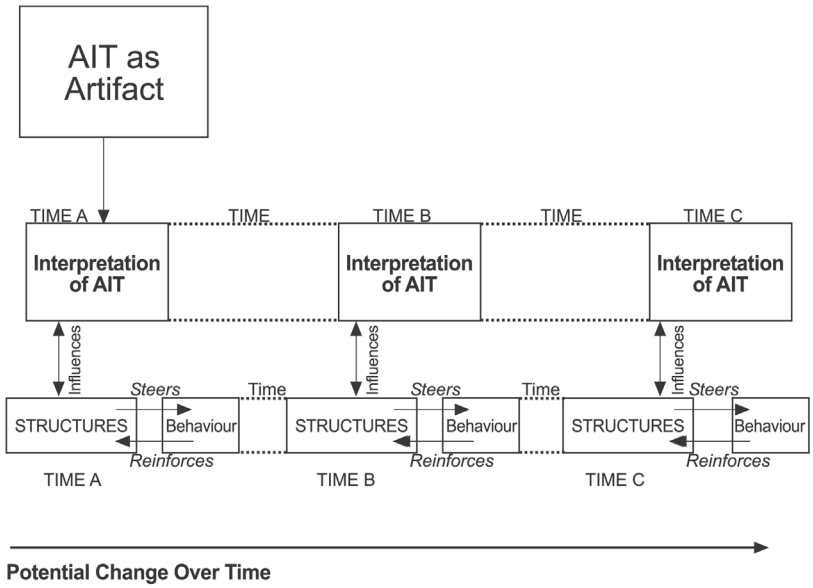

Figure 2.
Interplay of factors causing potential change of structures and behavior

behavior and use) that actually emerge as organizational members, influenced by the patterns of thinking and behavior that define structures within their own organizations, adopt, modify through improvisation, resist, or even reject AIT designers' intended use of the technology (Figure 2 describes that interplay).

In summary, as a result of ongoing actions of organizational members, AITs are adapted into organizational practice. As we indicated earlier, the degree of adaptation of the same technology may vary from organization to organization depending on the unique structures of the respective organizations and the degree of malleability characterizing these structures. These differences in adaptation reflect the degree of change the technology has triggered within an organization. This change may enhance organizational effectiveness or undermine it. For example, electronic brainstorming software can create structures of interaction that help organizations in extremely competitive environments to generate new product ideas. However, that same brainstorming software may also create interactions that undermine hierarchy in an organization that relies on chain of command to organize and be effective. As explained by DeSanctis and Poole (1994):

> Because the new structures offered by technology must be blended with existing organizational practices, radical behavior change takes time to emerge, and in some cases may not occur at all. Structuration models go beyond the surface to consider the subtle ways in which technology impacts may unfold.

Tension often arises between the structures of intended use embedded within the advanced technology by its creators and sponsors and the structures that emerge from action as people within different organizational contexts (and the different structures that define appropriate action within those contexts) interact with the technology. Orlikowski (1992) characterizes this tension as the "duality of structure", a phenomenon that is often invisible within organizations. Organizational members are often unaware of their own patterns of technology use and the structures that steer that use, because of their tendency to reify them, or to treat them as a "black box".

In such circumstances, users do not assess or diagnose the technology as an interaction between the structures of use embedded in the technology's material characteristics and users' organizational structures that steer their specific uses. This lack of mindfulness or awareness can cause problems because, debate, dialogue, and other forms of interaction that result in new learning – what Argyris (1999) calls double-loop learning – are absent. Consequently, organizational members remain unaware of the degree of influence AITs are having on their structures and actions; moreover, they are unable to determine if their own organizational structures and the actions they produce are limiting their understanding and use of the AIT. Interestingly, action research that uses structuration theory as a theoretical lens can increase

organizational members' mindfulness or awareness about strategic AIT appropriation.

The value of structuration to evaluate the impact of the adoption of AITs has direct relevance to logistics. While physical goods cannot be moved as rapidly as information, expectations of what logistics processes and the technologies supporting them can accomplish have risen with rapid improvements in IT. Accordingly, the physical distribution of goods is being restructured to take advantage of increased efficiencies in IT, notably in the ease of communication between the different components of the supply chain. IT has become a key enabler of the integration of logistics functions (Zacharia, 2001). Given the pervasive role of IT in logistics, and the well-established use of structuration theory to examine IT-enabled behavioral change, we believe there is considerable potential for the use of structuration theory in logistics research.

The next section applies these structuration concepts to a logistics case. This application will demonstrate how the structuration theory lens can be used to surface critical issues in AIT adoption and adaptation.

Logistics case study – the global transportation network

This case study uses broad-based structuration theory concepts to discuss the adoption by the US Department of Defense (DoD) of the global transportation network (GTN), a complex AIT. We first discuss the organizational context for the case, then describe the impact of GTN on information processing, and finally suggest how structuration theory could be used to evaluate DoD organizational challenges in adopting and adapting to GTN.

Organizational context

Logistics organizations within DoD are responsible for ensuring the worldwide distribution of large quantities of equipment and supplies to both fixed locations (such as military bases) and mobile units (such as ships and infantry battalions). The military supply chain also includes thousands of suppliers and warehouses, providing material ranging from the commonplace (food and office supplies) to the complex (spare parts for aircraft and ships).

The performance of this large, complex DoD logistics system is affected by constraints on access to accurate demand information, disturbances due to breakdowns in transportation and communications, the number of decision points where information is concentrated and acted on, time lags for value and non-value added processes, and decision rules for activities such as order placement, inventory levels, or the dispatching of vehicles (Evans *et al.*, 1993). Traditionally, the many organizations involved in the end-to-end military supply chain – referred to colloquially as "factory to foxhole" – have each pursued their own objectives leading to different behavioral patterns. For example, a military unit charged with warehousing supplies will seek to deliver items to its loading dock as quickly as possible, without regard for the length of

time those supplies spend waiting there to be picked up for delivery to the customer. Alternatively, the commander of a squadron of transport aircraft might be rewarded for dispatching fully loaded planes, rather than for getting urgently needed items to end customers as soon as possible. This tradition of autonomy, which contributes to incongruous goals, has made inter-organizational coordination difficult and consistent implementation of new technologies challenging.

To combat these challenges of technology implementation and conflicting goals, DoD has attempted to emulate the private sector by implementing AITs so that the timely, accurate information the technology purportedly provides will eliminate needless process steps, reduce inventories, and ultimately cut logistics costs (US Department of Defense, 2001a). As explained by a former Secretary of Defense, the department "spends more than $80 million annually on logistics but the logistics performance (e.g. responsiveness, service, value, readiness) does not match this investment" (US Department of Defense, 2001b).

Impact of GTN on information processing

The GTN is a Web-based family of information systems developed to capture, integrate, and disseminate in "real time", information about the status of all shipments to all users and providers of transportation in the DoD. The goal of the GTN is to improve the performance of the military's end-to-end supply chain. Bundled within the GTN are the Web-based collection and dissemination of shipment tracking and tracing data, group decision support systems, and e-mail. These significant technologies represent both physical and social objects that, according to DeSanctis and Poole (1994), could disrupt DoD supply chain processes and members' behavioral routines as well as the structures that shape and reinforce them. In short, as the GTN is implemented, it may modify organizational routines and structures, and in turn find itself modified by them (US Transportation Command, 2000).

For example, providing access to tracking and tracing data for all shipments allows an end customer (such as a ship or an infantry battalion) to evaluate the performance of transportation carriers, and provide feedback on that performance. That feedback might then result in faster or more frequent transportation services, which would need different tracking and tracing technologies. Similarly, as end customers become accustomed to more accurate status information on their shipments, they will place a higher degree of confidence in the reliability of the supply chain and expend less effort on ensuring that deliveries will actually arrive as promised. Users might also make less use of more expensive, high-priority shipping if they have more confidence in the accuracy and reliability of logistics information such as forecasted arrival dates. Finally, inventory levels – and warehousing space requirements – may decline as customers reduce safety stocks due to more

reliable information from, and better communications with, upstream organizations.

The GTN is intended to lead to changes in thinking and behavior among the various participants in the DoD supply chain. However, given the large number of DoD users with different goals, measures of performance effectiveness, control systems, and thus behaviors and their reinforcing structures, users undoubtedly will interpret the GTN in unique ways, and perceive differently, the value of the quantity and quality of the system's data. For example, military units using medical supplies vary from hospitals and clinics located throughout the USA and abroad to deployed units such as the medical staffs of aircraft carriers in the Mediterranean or of army units in Afghanistan.

Military units whose structures are malleable enough to adopt the behavioral changes created by GTN might find that their improved visibility over inventories and shipments and their ability to provide suppliers, warehouse personnel, and intermediary shippers with rapid feedback about their supply concerns could reduce their use of high-priority (and more expensive) shipping and even cause them to reduce their inventories. In contrast, units that find it difficult to incorporate GTN into their work because of rigid structures and behavioral routines may find that neither their use of expensive, high priority shipping nor their inventory levels have changed. As Orlikowski (1992) explained, there may also be tensions between the intended and actual uses of the GTN applications. In many cases, individual perceptions of GTN data reliability – such as the forecasted arrival date for an ordered item – will govern GTN interpretation and determine whether users actually change their behavior. Additionally, the perceived value and credibility of logisticians will impact the degree of GTN adoption.

Applying structuration theory to GTN

We briefly outline in this section how structuration concepts could be used to understand patterns of GTN adoption and implementation at military hospitals, commonly called military treatment facilities (MTFs). By providing a Web-based interface for carrying out transactions not requiring specialized logistics training, the GTN, according to its system designers, should make it much easier for medical personnel to obtain information on the status of their shipments. What is uncertain, is how senior MTF leaders will interpret GTN and frame its use for system users, the impact that different MTF structures will have on GTN interpretation, and the extent to which current behaviors and structures are malleable enough so that GTN can allow for different work routines.

Military medical staff have an implicit hierarchy: physicians (particularly surgeons and other specialists), dentists, allied health specialists, nurses, and other support staff, including logistics personnel among others. This implicit hierarchy is reinforced by an explicit one – rank and chain of command. Not

surprisingly, physicians, particularly surgeons, often occupy senior management positions in MTFs. Communication interactions and the implicit and explicit hierarchy influences other behavioral patterns heavily. This causes structures of control, autonomy, communication, and negotiation to affect and be affected by GTN; however, as indicated earlier, these structures' malleability and the disruption or slippage the GTN could cause, may vary across MTFs.

For example, if a physician, say a director of surgical services, initially takes interest in GTN and monitors its use, then his interpretation of GTN, his perception of its value, his belief in the reliability of the data, and willingness to change behavior – careful monitoring of expensive surgical supplies and concern for inventory costs – will affect the extent to which GTN is used in the surgical services directorate and, possibly, throughout the MTF and the changes, if any, in logistics staff behavior. In short, contextually embedded MTF dynamics will help determine structures that will, in turn, influence interpretation of GTN, its degree of use, the people who use it, and the degree of difference in roles and behavioral routines.

Different MTF organizational context factors explain why identical technologies can lead to different structures. A surgical services director in a theater MTF (such as in Saudi Arabia during the 1990-1991 Persian Gulf War) where supply issues are paramount may interpret, value, and implement GTN differently from a director in a large tertiary care MTF located within the USA that has inventory space, ready access to supplies, and an ample budget. Similarly, a surgical services director who has a shallow understanding of GTN uses or believes that using the system features are not worth the training and effort required may create what DeSanctis and Poole (1994) call an unfaithful adoption. Unfortunately, the MTF logistics staff, who may interpret the GTN differently than the surgical services director, and see needed changes in behavior to effectively use GTN, could find it extremely difficult to change structures of thinking and action that would result in GTN adoption resembling the expectations of its system designers.

Structuration theory can help researchers understand a range of other MTF behavioral dimensions created by GTN. If physicians delegate GTN assessment and implementation to logistics specialists, a number of interesting possibilities could occur. Logistics staff may interpret GTN as a threat to their power base and may believe that the technology will alter their roles and behaviors to their professional detriment. They may believe that the system may cause medical personnel to rely less on the logisticians for advice and assistance in ordering supplies, or lead to an erosion in the trust between the two groups as medical personnel might use GTN data to question the performance of the logistics staff.

Furthermore, if GTN is implemented, logisticians may feel excluded from the supply chain. As their customers (medical personnel) become familiar with

GTN's ordering, tracking and tracing systems, they may find they can bypass the logistics staff, and perhaps even cease requesting logistics-related advice as well. Logisticians might lose their visibility and authority over their customers' supply chain and be called in only to "clean up the mess" when customers make uninformed decisions on logistics issues – such as order priority, choice of transportation, packaging, or order quantities.

These examples of potential GTN implementations at MTFs have two key features. First, the process of adaptation resulting from implementation and use of the GTN will take place over time. Second, organizational context factors can create differences in MTF structures that will influence significantly how the GTN affects the working relationships and routines among medical and logistics staffs.

Data gathering methods needed to apply structuration theory

Methods such as interviews, participant observation, and analysis of logistics data could be used to evaluate the influence of the GTN over time on organizational routines and the structuration effects of the new technologies on the organizations within the medical supply chain that supports MTF work. Observational data is needed to understand the GTN's effect on current organizational structures and the impact these structures will have on GTN adoption. And, as indicated earlier, this data must be obtained over time, resulting in the need for a longitudinal study.

Short time spans of observed GTN use are inadequate to capture changes in GTN adaptation because existing behavioral patterns (i.e. structures) may be modified over a time span of say, four, six or even ten months by the features embedded in the GTN and the changing behavior resulting from individual interpretations of GTN use and value based, at least initially, on current structures. Furthermore, data about GTN adaptation should not be obtained retrospectively. As Griffith (1999) observes, respondents tend to gloss over important details that caused adaptations to AITs. Finally, these respondents' retrospective descriptions are heavily biased by the current structures about AIT.

To collect this detailed observational data about GTN adoption and use, researchers should do field work and could use ethnographic data collection methods (Geertz, 1973; Harvey and Myers, 1995). This approach requires entrée into the organization and access to people, places, and communication events (meetings, e-mail message traffic, conference calls, etc.) Furthermore, researchers may need to triangulate their data – in other words, to use multiple information sources to verify the legitimacy of an observation or claim – in order to make meaningful generalizations about the data before applying structuration concepts for analysis.

Researchers, though, need different data sources to understand the context of GTN adaptation, the ongoing behavioral routines before GTN was

implemented, and people's interpretation of their actions. To obtain context knowledge and the social and historical background of the research setting, researchers can look to in-house documents, external studies and periodicals; interviews with line managers, support staff and technical specialists, and other archival information.

Obtaining data about actual GTN practice and people's understanding of that practice requires interviews and participant observation, in this case, at the MTFs being studied. These interviews can be semi-structured (open-ended questions) or open-ended informal (serendipitous conversations while at lunches, in the coffee room, in the mail room, etc.). The semi-structured interviews should be tape-recorded (if possible) so that responses can be transcribed and then analyzed to determine patterns, themes, and interpretations of GTN technology and behavior. At the very least, the researcher should take careful field notes during the interviews and should review and revise those notes within 24 hours of the interview – commonly referred to as the "24 hour" rule in fieldwork. Open-ended, informal interview data should be recorded immediately after it is obtained.

As its name implies, participant observation involves direct observation of organizational events. This direct observation could include viewing the actions and interactions of people using the GTN, listening carefully to their comments and conversations, attending meetings involving discussion of GTN policy and use, and a host of other circumstances. During and after these observations, the researcher needs to create a behavioral record for every procedure observed.

Limitations of interpretivist methods to apply structuration theory

Clearly, qualitative, interpretivist data gathering methods required to apply structuration theory to GTN in particular and AITs in general raise practical concerns and philosophical questions. We discuss several that seem most salient to this methodology. Some practical concerns include entrée to the organization(s), time required at the research site to gather data, costs associated with transcription of data, and, perhaps most importantly for junior faculty, a limited number of published articles in proportion to time devoted to the research. At some institutions, this type of research may not result in the number of journal articles that junior faculty may be required to produce to be awarded tenure.

Another often-stated limitation is the generalizability of research results based on "thick", detailed descriptions of one or several research sites. Interpretivist critics question if meaningful propositions, generalizations, or models can be generated from unique contextual details of one or several organizations. However, Klein and Myers (1999) have pointed out that the theoretical framework applied to the detailed data – in this case structuration theory – provides the generalizability of results across organizations. Another

important limitation is the effect the researchers' observations have on organizational practice and the impact their own interpretive lenses have on information observed, methods in which it is collected, and how it is classified and ultimately interpreted. Skilled ethnographers blend into the context; consequently, their presence in the organization is less of an issue than critics unfamiliar with ethnographic techniques claim.

Assessing the impact of the researcher's interpretive lens, more often called researcher bias, is more complicated. Interpretivism does not assume that "data" or "facts" are independent entities waiting to be discovered and gathered, like rare shells on the seashore. Alvesson and Skoldberg (2000) convincingly argue that interpretation plays a role on every level of knowledge-making, in every kind of research including choice and handling of data and conclusions about what the data mean: unmediated (purely objective) data or facts do not exist. Self-aware qualitative researchers recognize that research data is produced as part of the social interaction of the researcher with the participants.

Specifically, interviews and the questions asked, informal contacts, and requests for specific documents influence how respondents view their organizational worlds and how they describe and present that world to researchers. This influence affects the kind of data the researcher obtains. Furthermore, researchers' noticing and selection of data, their documentation of it, their organizing of it, their interpretation of it, and the text produced to communicate that interpretation are steered by their own theories of knowledge (e.g. positivist or interpretive), the repertoire of theoretical frameworks with which they are familiar, and the community of researchers they identify with as well as the journals in which they publish. On a more personal level, the research story that is told is filtered through the researchers' own personal background, their likes and dislikes, and their strengths and weaknesses. In short, interpretivists argue that data and the knowledge that results from its analysis and interpretation is co-created or mutually constructed by the interaction between respondents and researchers. Furthermore, conscientious qualitative researchers must be "reflexive". In other words, they should be interpreting their own interpretations, assessing their own theoretical perspective from other perspectives, and critically examining their own authority as interpreter and author (Alvesson and Skoldberg, 2000).

Final observations

This project's goal was to introduce logistics researchers to structuration theory as a framework for understanding the complex behaviors that influence AIT adoption. Heeding the calls of Kent and Flint (1997), Mentzer (2001) and Näslund (2002), we too believe behavioral research, particularly within the area of complex information technologies, is needed to better understand the factors that influence supply chain interactions that can either add value to customers

and organizations or cause supply chain breakdowns. Obviously, structuration theory is but one of a number of powerful theoretical frameworks that can help us understand and explain the complexity of SCM behavioral dynamics. Furthermore, we have pointed out limitations of variance theories and the strong hold these theories have on researchers' understanding of AIT's effect on people, processes, and logistics systems.

We recognize that research questions determine the type of research design and theoretical frameworks to assess data. As a result, we are not arguing that interpretivist theoretical frameworks requiring qualitative research designs should replace those needing quantitative methods. However, we do recognize that researchers may find themselves embedded in largely tacit conceptual frameworks – current, discipline-based structures. These structures and their characteristic frameworks may make it difficult for researchers to construct research questions that force them to move beyond variance theories and adopt interpretivist frameworks and the process theories that enable examination of the behavioral components of logistics. Structuration theory can help us understand that difficulty.

Many logistics researchers have structures (implicit stores of knowledge and codes of action) generated and sustained by their disciplinary community. The structures that this community has created steer its members' interpretive schemes about what constitutes normative social science, their theories about organizations, and, as a result, the research questions, methodologies, and theoretical frameworks they used to interpret data and generate knowledge. Examining the language in the published research as an artifact of these structures, it becomes clear that the dominant or root metaphor of logistics researchers is the organization as a machine and its members as rational actors (Mears-Young and Jackson, 1997; Lambert *et al.*, 1998).

Social science researchers have long recognized that we make sense of our internal and external worlds through symbol systems, particularly language; and that language shapes thinking and steers action. Language in tandem with action both reveals and reaffirms structures. Dominant or root metaphors are organizing language frameworks that give members of a social group (e.g. logistics researchers) a coherent way of codifying, sorting, and hence giving meaning to their experience (Morgan, 1986; Sarbin, 1986; Srivastva and Barrett, 1988). Because a root metaphor can pervasively construct and shape experience, it can function as a perceptual control system that guides thinking and action along a particular, delimited course that is congruent with the root metaphor (Turner, 1974). In short, root metaphors can play an important role in the structuration process.

Several manifestations of this metaphor of organization as machine, and individuals as rational actors, are the belief that behavior can be predicted and modeled versus understood only within organizationally specific contexts, that logistics systems are exclusively external and objective rather than the product

of the thinking, action and ongoing interpretations of that action of organizational members. The result of this type of thinking has been research dominated by a macro level of analysis versus a blend of macro and micro levels, and research methods dominated by surveys versus methods such as case studies, ethnography, grounded theory, naturalistic inquiry, action research, discourse analysis, or other micro-level methodologies.

As we have seen, AITs can trigger alterations in structures, but growth inducing generative metaphors can also trigger change. In essence, logistics research may need a growth-inducing language about logistics managerial behavior, a new set of theoretical constructs that will help researchers reframe and thus "resee" their thinking and research designs in ways that help them break from variance theories and the larger positivist paradigm. Structuration theory, which is emerging as an important theoretical lens for the assessment of the organizational impact of information systems, is one powerful interpretive framework that provides a new language to understand and assess managerial action in logistics.

While the rapid evolution of IT has transformed logistics, research in logistics stands at a crossroads. There is now a significant need to broaden the methods used to understand the evolution of logistics. The adoption and adaptation of information technologies by individuals and organizations cannot be effectively described on a cause-and-effect basis alone. New theoretical frameworks such as structuration theory are needed to better understand behavior within supply chains.

References

Alvesson, M. and Skoldberg, K. (2000), *Reflexive Methodology: New Vistas for Qualitative Research*, Sage Publications, Thousand Oaks, CA.

Argyris, C. (1999), *On Organizational Learning*, 2nd ed., Blackwell Business, Malden, MA.

Barley, S.R. (1986), "Technology as an occasion for structuring: evidence from observations of CT scanners and the social order of radiology departments", *Administrative Science Quarterly*, Vol. 31 No. 1, pp. 78-108.

Choi, T.Y., Dooley, K.J. and Rungtusanatham, M. (2001), "Supply networks and complex adaptive systems: control versus emergence", *Journal of Operations Management*, Vol. 19 No. 3, pp. 351-66.

Cooper, M.C., Ellram, L.M., Gardner, J.T. and Hanks, A.M. (1997), "Meshing multiple alliances", *Journal of Business Logistics*, Vol. 18 No. 1, pp. 67-89.

DeSanctis, G. and Poole, M.S. (1994), "Capturing the complexity in advanced technology use: adaptive structuration theory", *Organization Science*, Vol. 5 No. 2, pp. 121-47.

Dunn, S.C., Seaker, R.F. Stenger, A.J. and Young, R. (1993), "An assessment of logistics research paradigms", Working Paper 93-5, Center for Logistics Research, Pennsylvania State University, University Park, PA.

Edwards, T. (2000), "Innovation and organizational change: developments towards an interactive process perspective", *Technology Analysis & Strategic Management*, Vol. 12 No. 4, pp. 445-64.

Evans, G.N., Naim, M.M. and Towill, D.R. (1993), "Dynamic supply chain performance: assessing the impact of information systems", *Logistics Information Management*, Vol. 6 No. 4, pp. 15-25.

Geertz, C. (1973), *The Interpretation of Cultures: Selected Essays*, Basic Books, New York, NY.

Giddens, A. (1979), *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis*, University of California Press, Berkeley, CA.

Giddens, A. (1984), *The Constitution of Society: Outline of the Theory of Structure*, University of California Press, Berkeley, CA.

Griffith, T.L. (1999), "Technology features as triggers for sensemaking", *Academy of Management Review*, Vol. 24 No. 3, pp. 472-88.

Harvey, L. and Myers, M.D. (1995), "Scholarship and practice: the contribution of ethnographic research methods to bridging the gap", *Information Technology & People*, Vol. 8 No. 3, pp. 13-27.

Kent, J.L. and Flint, D.J. (1997), "Perspectives on the evolution of logistics thought", *Journal of Business Logistics*, Vol. 18 No. 2, pp. 15-29.

Klein, H. and Myers, M. (1999), "A set of principles for conducting and evaluating interpretive field studies in information systems", *MIS Quarterly*, Vol. 23 No. 1, pp. 67-93.

Lambert, D.M., Cooper, M.C. and Pagh, J.D. (1998), "Supply chain management: implementation issues and research opportunities", *International Journal of Logistics Management*, Vol. 9 No. 2, pp. 1-19.

Leavitt, H.J. and Whisler, T.L. (1958), "Management in the 1980s", *Harvard Business Review*, Vol. 36 No. 6, pp. 41-8.

Lewis, I. and Talalayevsky, A. (2000), "Third-party logistics: leveraging information technology", *Journal of Business Logistics*, Vol. 21 No. 2, pp. 173-85.

McGinnis, M.A., Boltic, S.K. and Kochunny, C.M. (1994), "Trends in logistics thought: an empirical study", *Journal of Business Logistics*, Vol. 15 No. 2, pp. 273-303.

Markus, M.L. and Robey, D. (1988), "Information technology and organizational change: causal structure in theory and research", *Management Science*, Vol. 34 No. 5, pp. 593-8.

Mears-Young, B. and Jackson, M.C. (1997), "Integrated logistics – call in the revolutionaries!", *Omega*, Vol. 25 No. 6, pp. 605-18.

Mentzer, J.T. (2001), "Managing the supply chain: managerial and research implications", in Mentzer, J.T. (Ed.), *Supply Chain Management*, Sage, Thousand Oaks, CA, pp. 437-61.

Mentzer, J.T. and Kahn, K.B. (1995), "A framework of logistics research", *Journal of Business Logistics*, Vol. 16 No. 1, pp. 231-50.

Morgan, G. (1986), *Images of Organization*, Sage, Beverly Hills, CA.

Näslund, D. (2002), "Logistics needs qualitative research – especially action research", *International Journal of Physical Distribution & Logistics Management*, Vol. 32 No. 5, pp. 321-38.

Orlikowski, W.J. (1992), "The duality of technology: rethinking the concept of technology in organizations", *Organization Science*, Vol. 3 No. 3, pp. 398-427.

Sarbin, T.R. (1986), *Narrative Psychology: The Storied Nature of Human Contact*, Praeger, New York, NY.

Sarkar, M., Butler, B. and Steinfield, C. (1998), "Cybermediaries in electronic marketspace: toward theory building", *Journal of Business Research*, Vol. 41 No. 3, pp. 215-21.

Seaker, R.F., Waller, M.A. and Dunn, S.C. (1993), "A note on research methodology in business logistics", *Logistics and Transportation Review*, Vol. 29 No. 4, pp. 383-7.

Srivastva, S. and Barrett, F.J. (1988), "The transforming nature of metaphors in group development: a study in group theory", *Human Relations*, Vol. 41, pp. 31-64.

Stock, J.R. (1990), "Logistics thought and practice: a perspective", *International Journal of Physical Distribution & Logistics Management*, Vol. 20 No. 1, pp. 3-6.

Stock, J.R. (1997), "Applying theories from other fields to logistics", *International Journal of Physical Distribution & Logistics Management*, Vol. 27 No. 9/10, pp. 515-39.

Stock, J.R. (2001), "The development of supply chain management thought: perspectives for the future", *Logistics Educators' Conference Proceedings*, Kansas City, MO, 30 September, pp. 149-171.

Turner, V.W. (1974), *Dramas, Fields, and Metaphors*, Cornell University Press, Ithaca, NY.

US Department of Defense (2001a), *Quadrennial Defense Review Report*, 30 September, p. 56.

US Department of Defense (2001b), "Annual report to the President and the Congress of William S. Cohen, Secretary of Defense", p. 212

US Transportation Command (2000), *Transportation for a New Millenium: USTRANSCOM 2000 Annual Command Report*, pp. 12-19.

Weick, K. (1990), "Technology as equivoque: sensemaking in new technologies", in Goodman, P. and Sproull, L. (Eds), *Technology and Organizations*, Jossey-Bass, San Francisco, CA, pp. 1-40.

Zacharia, Z.G. (2001), "The evolution and growth of information systems in supply chain management", in Mentzer, J.T. (Ed.), *Supply Chain Management*, Sage Publications, Thousand Oaks, CA, pp. 289-319.